Hydrologic and Hydraulic Considerations in Planning

Blending academics with real life application for Civil Works planners in a flexible manner

Instructors

- 7 total
- 2 with Ph.D., 4 with M.S.
- 4 with Planning experience, 3 with H&H experience
- 5 engineers, 1 biologist, 1 landscape architect

The difference between hydraulics & hydrology

- hydrology: the where and when of water

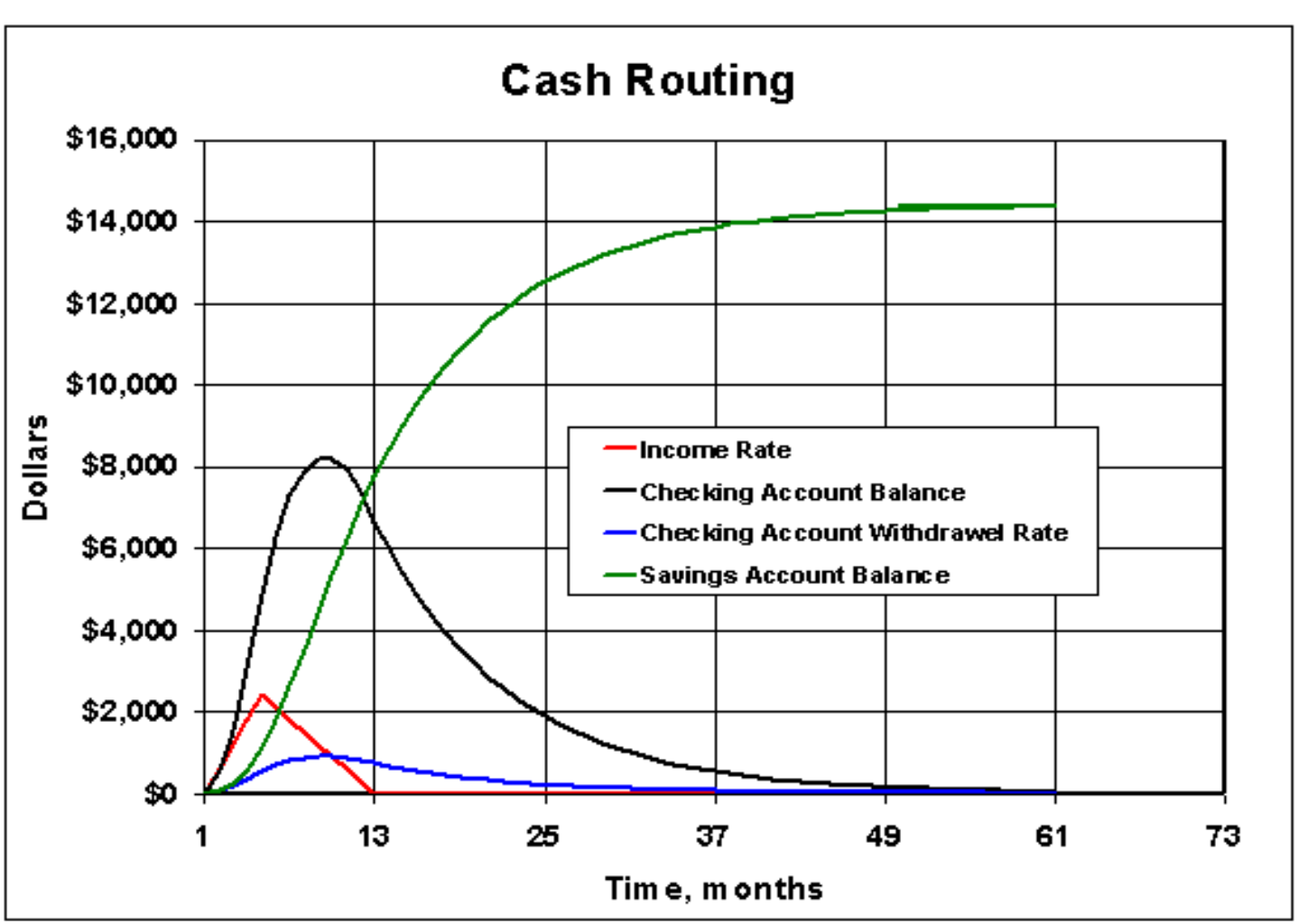
- hydraulics: water mechanics

H&H Fundamentals

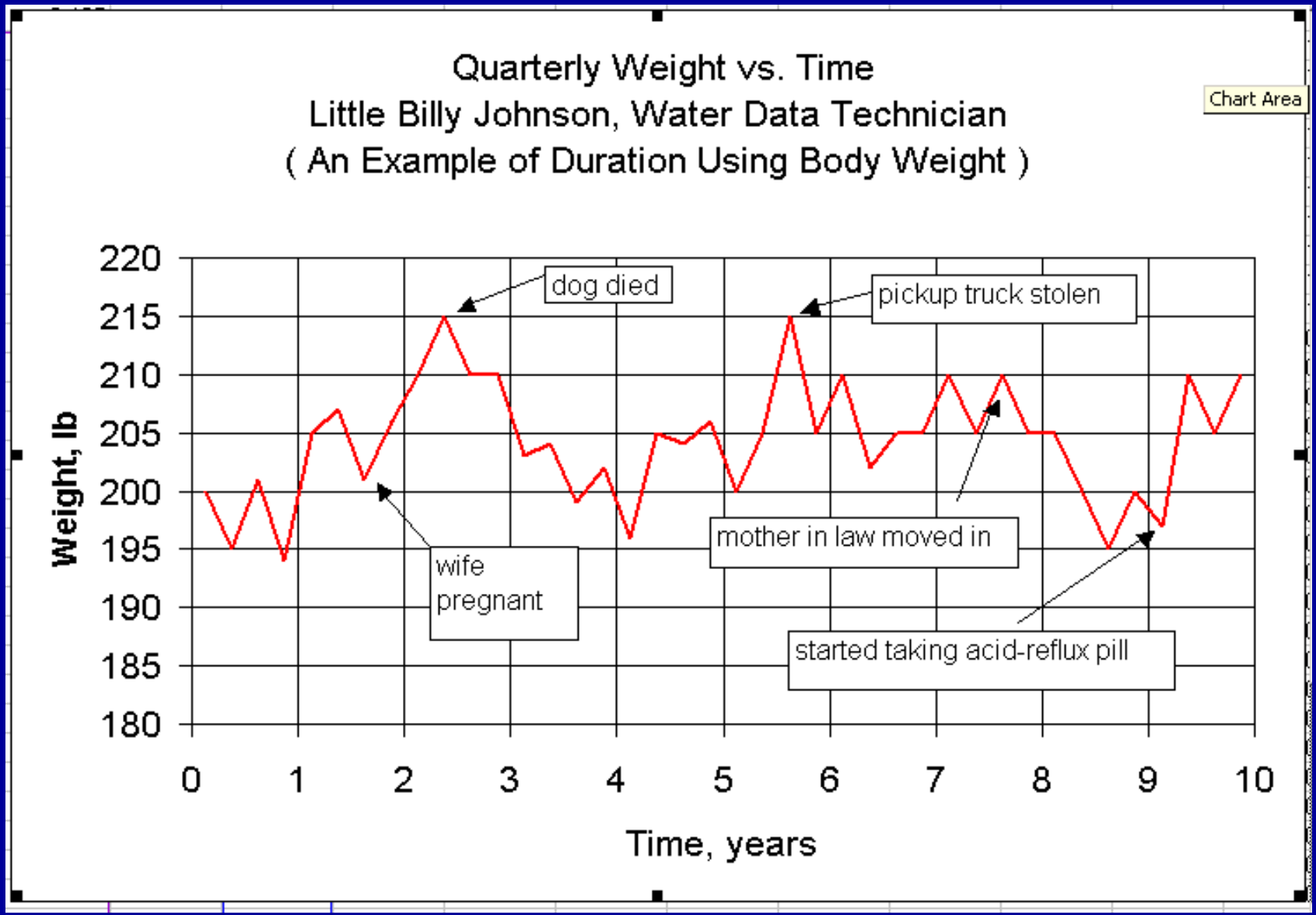
Hydrology

- **Watershed**
- **Hydrograph**
- **Routing**
- **Flood frequency**
- **Exceedance duration**

Cash Routing Analogy



Duration

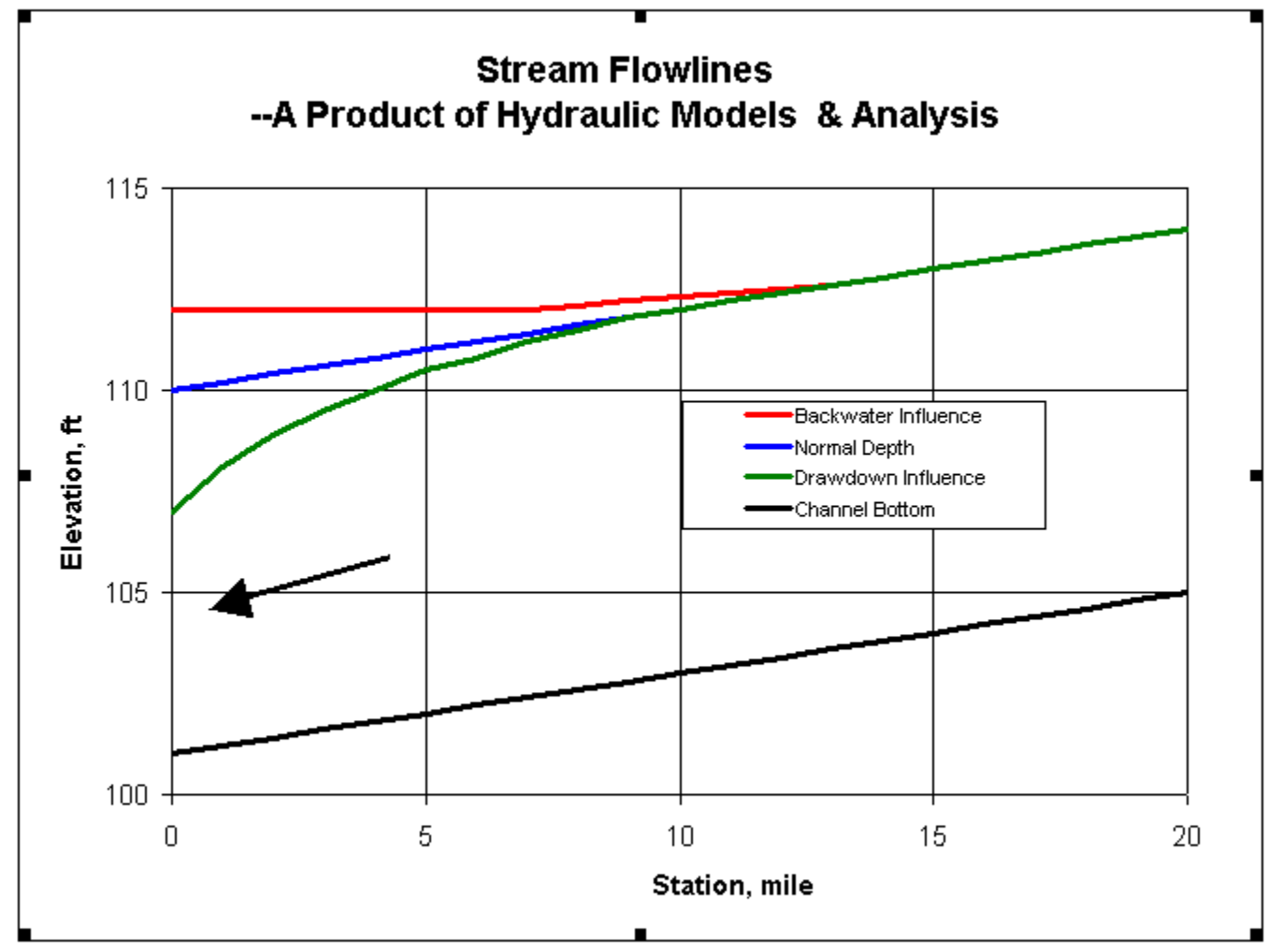

Quarterly Weight vs. Time
Little Billy Johnson, Water Data Technician
(An Example of Duration Using Body Weight)
Chart Area
Weight, lb
220
215
210
205
200
195
190
185
180
0
1
2
3
4
5
6
7
8
9
10
Time, years
dog died
pickup truck stolen
wife pregnant
mother in law moved in
started taking acid-reflux pill

H&H Fundamentals

Hydraulics

- **Flow Conveyance**
  - Closed conduit
  - Open channel
- **Head**
- **Flowlines**
- **Steady flow**

Flowline


Stream Flowlines
--A Product of Hydraulic Models & Analysis
Elevation, ft
115
110
105
100
0
5
10
15
20
Station, mile
Backwater Influence
Normal Depth
Drawdown Influence
Channel Bottom

H&H Fundamentals

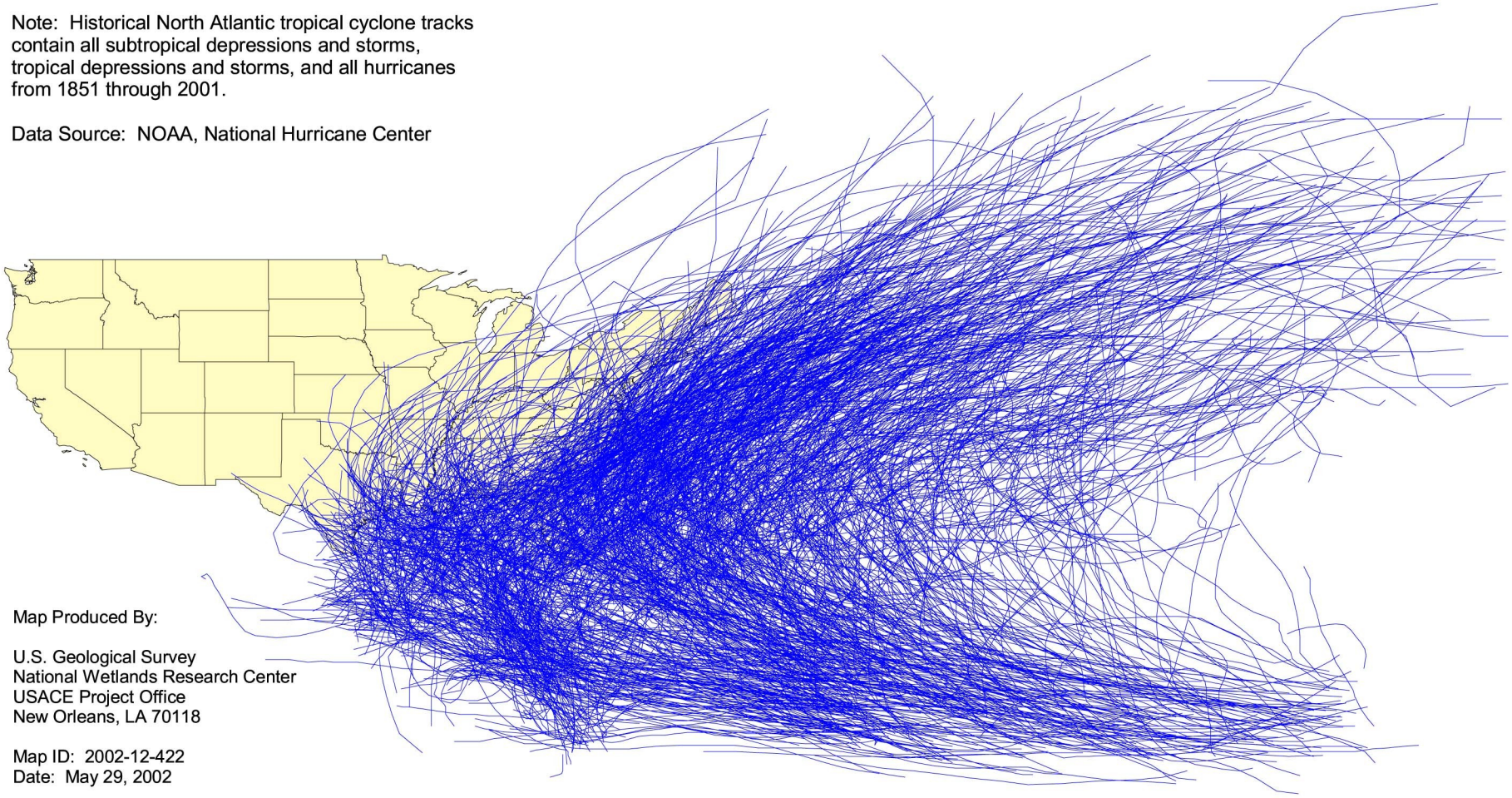
Coastal Engineering

- Causes of Damage in Coastal Areas
- Tides
- Storm Surge
- Hurricanes and Hurricane Storm Surge
- Coastal processes

Historical North Atlantic Tropical Cyclone Tracks
(1851 - 2001)

Note: Historical North Atlantic tropical cyclone tracks contain all subtropical depressions and storms, tropical depressions and storms, and all hurricanes from 1851 through 2001.

Data Source: NOAA, National Hurricane Center



Map Produced By:

U.S. Geological Survey
National Wetlands Research Center
USACE Project Office
New Orleans, LA 70118

Map ID: 2002-12-422
Date: May 29, 2002

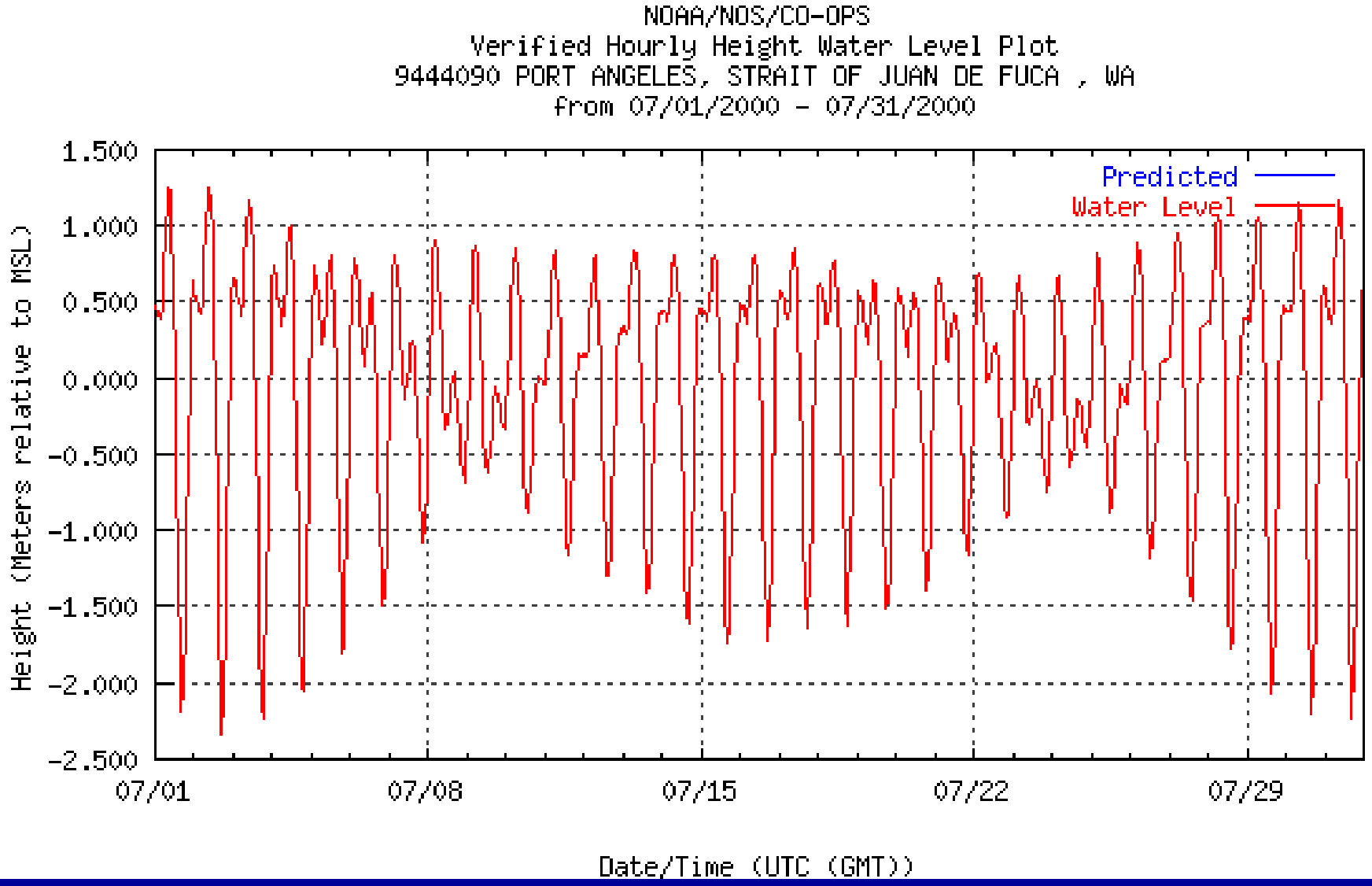
N

Storm Tracks
United States (lower 48)

2000 0 2000 4000

Miles

Port Angeles, WA, Tide



Components of Storm Surge

- **Reduced Pressure**
- **Wind Setup**
- **Wave Setup**

Concepts in Coastal Erosion

- Equilibrium Beach Profile
- On and off shore transport
- Longshore transport
- Sediment sources and sinks

Application of Academics to Planning of Civil Works Projects

Flood Damage Reduction

Flood Damage Reduction

- Typical H&H analyses in FDR studies
- Data needs to support the H&H effort
- Types of FDR alternatives
  - Structural
  - Non-structural
- H&H outputs

Dams and Reservoirs

Diversions

Channel Modifications

Levees and Floodwall

Monroe, LA Folding Floodwall

PUMPS

Structure Raising

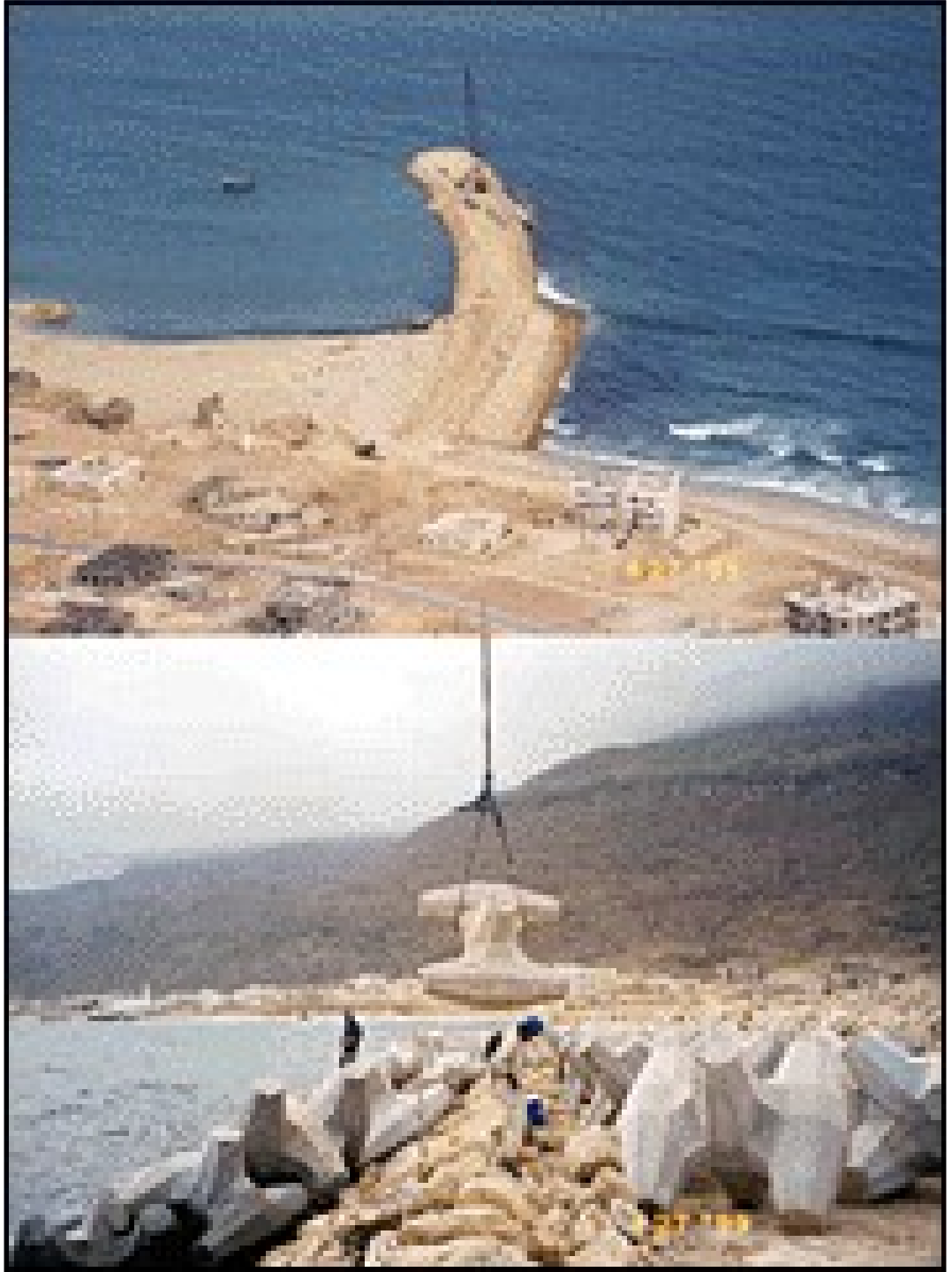
- Depth of water in structure from 2.5 feet to 5 feet
- Physically raise houses by use of jacks
- Cost: $40-$60/sf of house

Hurricane & Storm Damage Reduction

Coastal Flood Damage Reduction

Types of projects in coastal region

- Navigation projects
- Hurricane protection
- Erosion protection



Navigation

Navigation

- Data needs
  - Existing data
  - New data
- H&H design considerations
- Models used
- Types of alternatives

Deep Draft Navigation

John Day Lock and Dam, OR

Filling and Emptying Systems
Winfield Lock

Ice Congestion in Upper Lock

Factors:
- Ice supply
- River discharge
- Wind
- Project configuration upstream channel

Consequences:
- Brash ice congestion of lock chamber and miter gate recesses
- Ice in lock-filling intakes, valves
- Delays to navigation

Existing Solutions:
- Ice lockages
- Divert ice to dam gates, around river wall or through drift pass
- Skim ice over submergible lift gates or bulkheads
- Deflect ice with towboats or barges

Ecosystem Restoration

Ecosystem Restoration

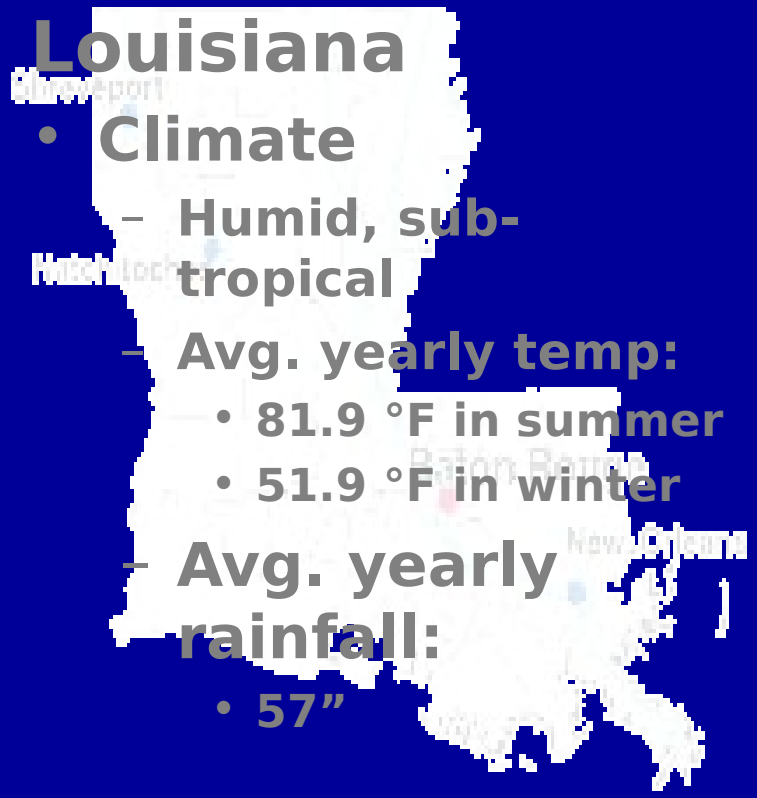
- Define ecosystem restoration functions
- Determine ecosystem stressors
- Types of H&H analysis
  - DDT
  - Natural stream design
  - Water quality
  - Groundwater
- Types of alternatives

Blackwater Conservation Area, LA

1985

Blackwater Conservation Area, LA

LA vs. AZ Comparisons



Louisiana

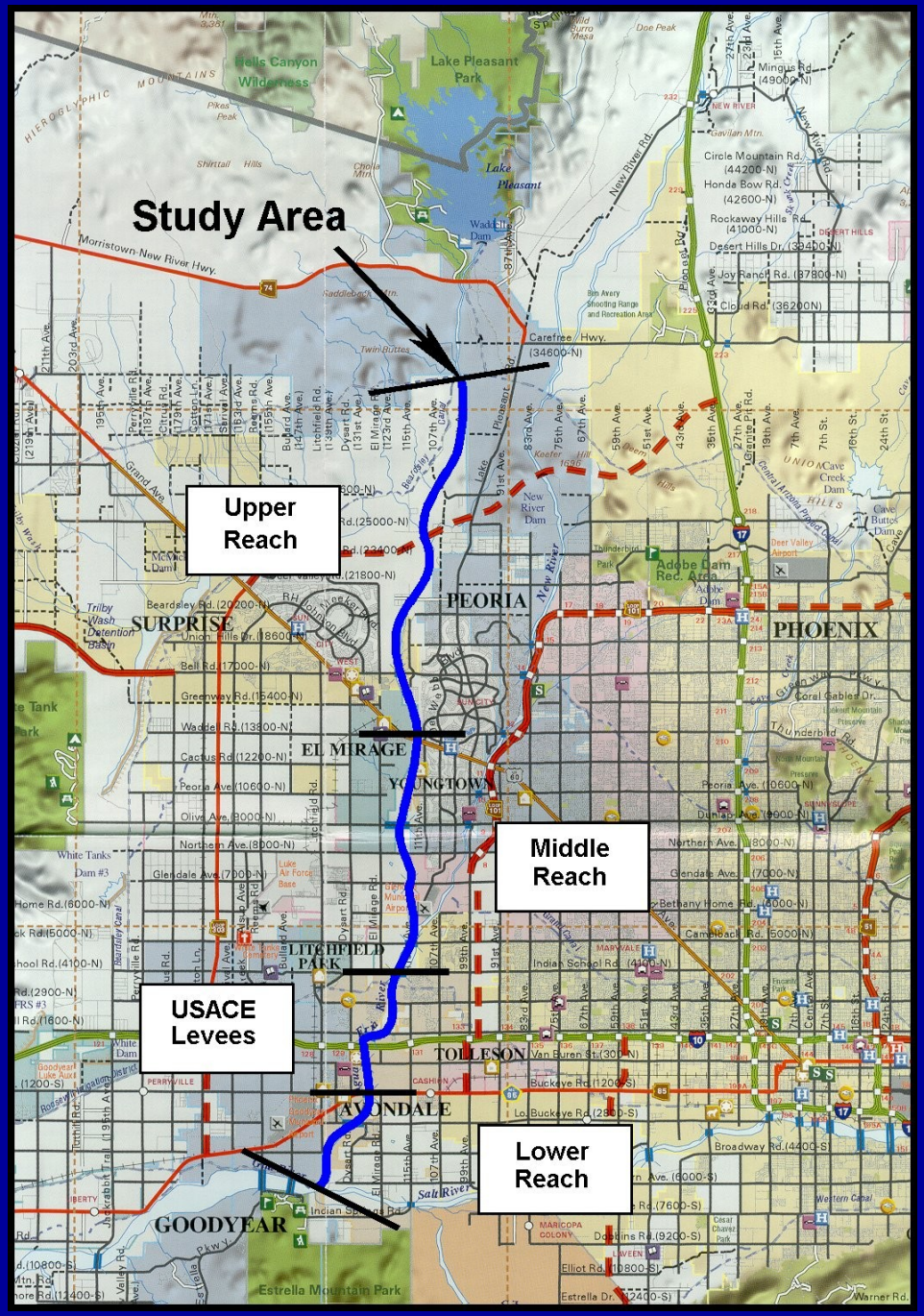
- Climate
  - Humid, sub-tropical
  - Avg. yearly temp:
    - 81.9 °F in summer
    - 51.9 °F in winter
  - Avg. yearly rainfall:
    - 57”

Arizona – Maricopa Co.

- Climate
  - Arid, desert
  - Avg. yearly temperature
    - 72 °F annual
  - Avg. yearly rainfall
    - 7.6”

Agua Fria Conditions

Agua Fria Goals



Changes In:

- Population
- Land Use

Tributaries Ecosystem Restoration Study Map
Franklin
Lincoln
Amite
Wilkerson
MISSISSIPPI
LOUISIANA
E. Feliciana
Degraded Reach
St. Helena
Amite River
E. Baton R.
Livingston
Denham Springs
Baton Rouge
Lake Maurepas
Lake Pontchartrain
Iberville
Ascension
St. John
St. James
New Orleans
MISSISSIPPI RIVER

GRANGEVILLE

Comprehensive Regional/Watershed

Major Causes Of Wetland Loss

Barrier Island Degradation

Subsidence

Storms

Sea Level Rise

Salt Water Intrusion

Sediment Reduction

Canals

Oil & Gas Development

Levee System

IMPORTANCE OF COASTAL LOUISIANA TO THE NATION

- **Billion dollar/yr coastal fishery industry**
  - **30% of nation's production**
  - **More than all of Atlantic seaboard production**
  - **More than any other Gulf state**

IMPORTANCE OF COASTAL LOUISIANA TO THE NATION

- **Coastal Louisiana has infrastructure for 17% of oil and 25% of natural gas produced in nation**

Potential Restoration Solutions

- **Types of Projects**
  - **River Diversions**
  - **Marsh Creation**
  - **Barrier Restoration and Shoreline Protection**

Scope, Schedule, and Cost

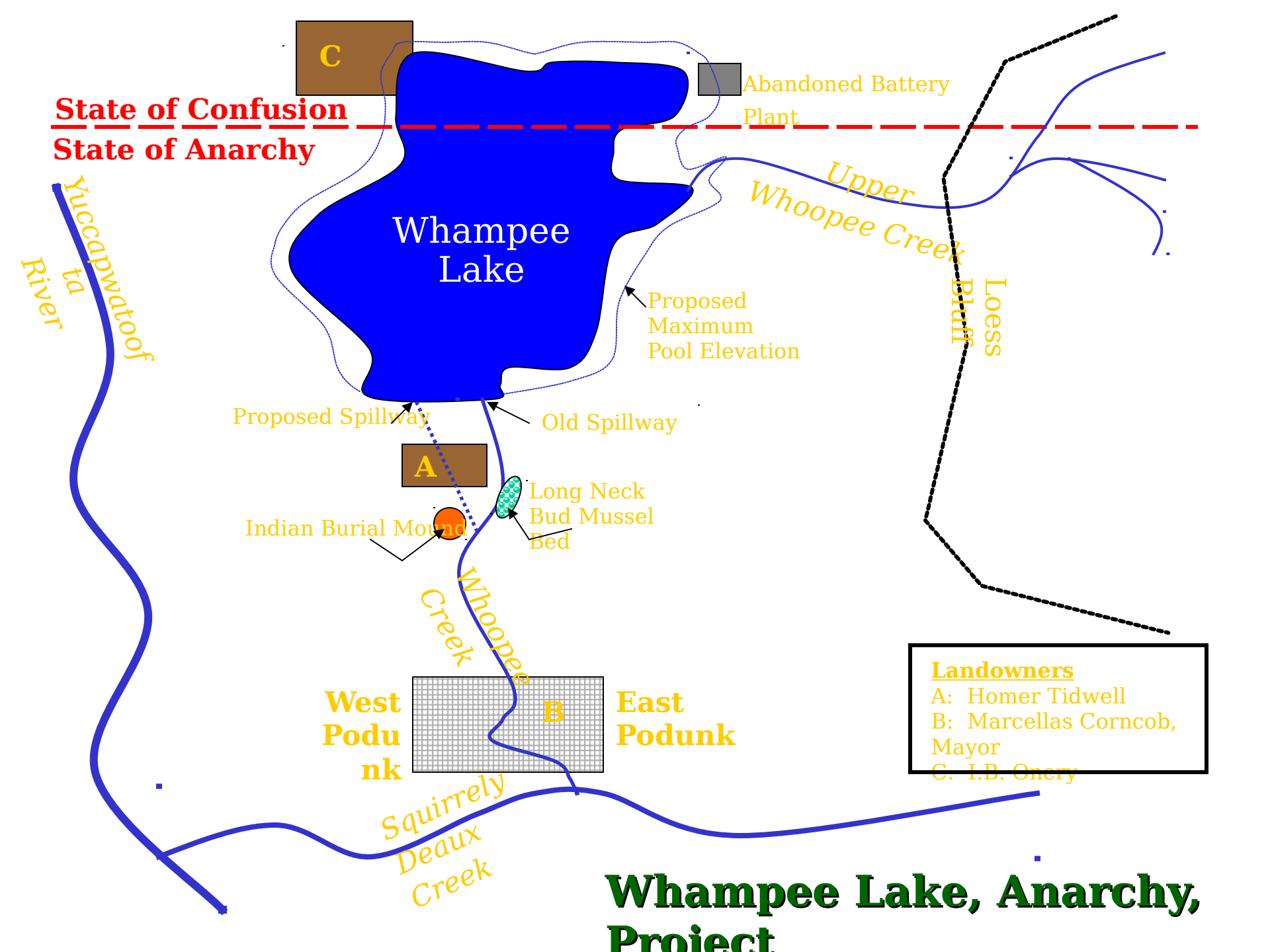
- Value of PMPs
- Importance of study scope
- Factors impacting scope
- Steps in developing a PMP

Scope vs. Consequences

Field Trip

- How to prepare
- How to conduct field trip
- Simulate a full team debriefing

Major Class Exercise


C
State of Confusion
State of Anarchy
Abandoned Battery Plant
Whampee Lake
Upper Whoopee Creek
Bluff
Loess
Yuccapwatoof ta River
Proposed Maximum Pool Elevation
Proposed Spillway
Old Spillway
A
Long Neck Bud Mussel Bed
Indian Burial Mound
Whoopee Creek
West Podunk
B
East Podunk
Squirrely Deaux Creek
Landowners
A: Homer Tidwell
B: Marcellas Corncob, Mayor
C: I.B. Onery
Whampee Lake, Anarchy, Project

Examples of Class Demonstrations